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RHYNCHOBOTHRIUM INGENS SPEC. NOV. A PARASITE OF THE DUSKY SHARK (*CARCHA-RHINUS OBSCURUS*) *

EDWIN LINTON

On August 14, 1905, I examined a lot of cestodes from a dusky shark which had been taken a few days before at Menemsha Bight. The shark measured 10 ft. 10 in. in length. The gills of a sword fish were found in the stomach. This fact, of course, is not to be interpreted as proof that the shark had eaten a sword fish. The gills had doubtless been picked up by the shark from offal thrown overboard by fishermen.

The cestodes found in the spiral valve were:—numerous specimens of *Crossobothrium angustum*, a few examples of *Phoreiobothrium lasium*, both being species of frequent occurrence in the dusky shark, and seven large strobiles of a species which, on account of the character of the hooks, suggested *Rhynchobothrium speciosum*, a species originally described from scoleces obtained from cysts in various teleosts.

These strobiles were much crumpled, since the spiral valve from which they were obtained had been lying in a weak solution of formaldehyde for a few days; tho contracted they were 410, 470, 500, 570, 600, 640, and 715 mm. long.

At the time of collecting the following data were noted:

Bothria somewhat broadly heart-shape, emarginate on posterior free border, widely flaring; breadth of head (marginal view of spreading bothria) 2.5 mm., of neck 1.8 mm.; length of neck 11 mm.; length of bothrium 1.8 mm., breadth 2.2 mm.; distance to first segment 80 mm.; maximum breadth of strobile 9 mm.; posterior segment, length 9 mm., breadth 7 mm. Hooks appear to agree with *R. speciosum*.

No report was made of this find further than the record of *Carcharhinus obscurus* as the final host of *R. speciosum* (U. S. Fisheries Bulletin, vol. xxxi, Part ii, p. 588).

On account of the massive character of the strobile but little knowledge of the structure could be gained from a study of unsectioned material.

The best results were obtained from sections made from pieces stained in toto in borax carmine, and further stained on the slide in a weak solution of indigo-carmin in 95% alcohol. In sections treated with indigo-carmin the following structures, which were either unstained, or but lightly stained by the carmine, were stained blue:—all muscle fibers, cuticula, fibers in the subcuticula, spermatozoa in the

* Contribution from the United States Biological Station, Woods Hole, Mass., and the Zoological Laboratory of the University of Missouri.

vas deferens, seminal vesicle, seminal receptacle, as well as those which surrounded the maturing testes. In like manner sharp differentiation was obtained between the cells of the shell gland and of the ovary. The cells of the ovary were deeply stained by the carmine and showed no trace of blue, while the nuclei only of the cells of the shell gland were red, the cytoplasm being strongly stained by the indigo. In cross sections of the spermduct and the oviduct the walls were blue and the surrounding gland-cells were red.

Scolex.—The bothria are two in number, broader than long, somewhat broadly heart-shape in general outline with the smooth margin slightly raised, and the posterior free border usually flaring. The bothria correspond to the flat surfaces of the strobile, i. e., dorso-ventral. In preserved specimens the neck has a tendency to twist so as to make the bothria appear to correspond in position to the narrow margins of the strobile. The neck is elongated, subcylindrical, of nearly uniform dimensions from a point near the bothria to the anterior ends of the slender contractile bulbs, where it increases slightly in breadth to remain unchanged to the base of the bulbs. In a specimen mounted in balsam the scolex measures 10.4 mm. from the anterior end of the bothria to the posterior end of the bulbs; a proboscis was estimated to be 2.8 mm. in length; bulbs, not very clearly outlined, measured 3 mm. in length and 0.4 mm. in diameter. Bulbs dissected out of another specimen measured 3.5 mm. in length and 0.36 mm. in diameter. A bothrium removed from the scolex and flattened measured 1.68 mm. in length and 1.89 mm. in breadth.

The proboscides are but partly everted, and moreover are much contorted, so that it is difficult to make a satisfactory interpretation of the plan of arrangement of the hooks. So far as I have been able to make it out the plan is as follows (Fig. 5): On the lateral aspect of the proboscis there is a longitudinal row of small, slender spines placed by twos in tandem (*a*). This row is flanked on one side by a row (*b*) of spines which vary greatly in shape. At the point represented in the figure, which is about one millimeter from the base of the proboscis, they appear in front view as short, broad, triangular spines corresponding in number to row (*a*) but uniformly placed, close together, the base of one slightly overlapping the base of the spine in front of it. Towards the base of the proboscis the spines of this row develop wide wing-like basal supports, from which the spine proper rises as a slender process which at first bends forward then turns towards the base of the proboscis in a short recurved hook (Fig. 9). On the other side of row *a* there is a row of slender hooks (*c*) smaller than *a*, and one half as many, each hook in this row corresponding in spiral arrangement with the anterior hook in each tandem pair in row *a*. Next to *c* is a series (*e*) of longitudinal rows, appearing in the spiral as five strongly

recurved, stout hooks, increasing in size in the direction away from *c*. The remainder of the spiral (*d*) is another series of longitudinal rows appearing in the spiral as five long, stoutish hooks, growing larger, in a direction away from *b*. The larger hooks in series *d* come to resemble those in series *e*. A spiral of one circumference, according to this interpretation, consists of the anterior hook of a tandem pair of *a*, one from row *b*, five in series *d*, five in series *e*, and one in series *c*. The posterior hook in each tandem pair of *a* and each alternate hook in *b* lie between adjacent spirals. The length of the longest hook is 0.075 mm.

Cross sections of the scolex in the region of the contractile bulbs show that these muscular organs have very thick walls on the inner side, which, on account of the criss-cross arrangement of the diagonal muscle fibers, looks something like sections of cardiac muscle. The wall is thickest on the side of the bulb which is next the axial center of the scolex, and thins out in each direction, until, at the lateral border it is made up of only the external sheath and the lining of the bulb cavity. Measurements made on one bulb showed the thickness of the inner wall to be 0.15 mm. and the outer wall at its thinnest point, 0.006 mm. The retractor muscle which inverts the proboscis is attached near the anterior end of the contractile bulb.

The neck of the scolex at its anterior end, that is, just behind the bothria, is elliptical in section with the longer axis dorso-ventral. The two diameters in a section made at this point measured 1.20 and 0.68 mm. respectively.

In a series of sections of the scolex clusters of what looked like oval cells with indistinct nuclei were noted in the central portions of the sections. The larger ones measured 0.036 by 0.015 mm. and were deeply stained. They represent in the scolex an axial core which began about 0.55 mm. from the anterior end and continued for a little more than a millimeter, with occasional scattering representatives in succeeding sections. On account of the fragmented condition of many they were interpreted to be calcareous bodies, altho no trace of concentric structure could be seen in any of them.

About at the point where the axial group disappears true ganglion cells make their appearance in two lateral groups. These ganglion cells are approximately circular in outline, their cytoplasm is finely granular and lightly stained. The majority of them are from 21 to 24 μ in diameter. The number in a lateral group in the earlier sections of the series is about 50, increasing in succeeding sections. The maximum was about 80. These lateral groups continue to be represented by many cells for a distance equivalent to about 2 mm. in the neck of the scolex, when their number is abruptly reduced. Groups of a half a

dozen or less appear in the sections back to the first appearance of the contractile bulbs where their number increases to 12 or more. They continue to the base of the contractile bulbs (Figs. 1 and 4).

The excretory vessels form a net-work of anastomosing vessels in the bothria. At the base of the bothria they merge into longitudinal vessels of which 12 or more were noted in a section made about midway between the bothria and the contractile bulbs. Behind the contractile bulbs the longitudinal vessels of the scolex unite to form the four lateral vessels, characteristic features of the cestode strobile. These are: one larger, ventral, and one smaller, dorsal, vessel near each margin. Of these the larger is the more laterally placed and lies between the smaller vessel and the lateral nerve cord. Both vessels pursue a somewhat tortuous course, the smaller especially so (Figs. 2, 4, 12, Text fig. A).

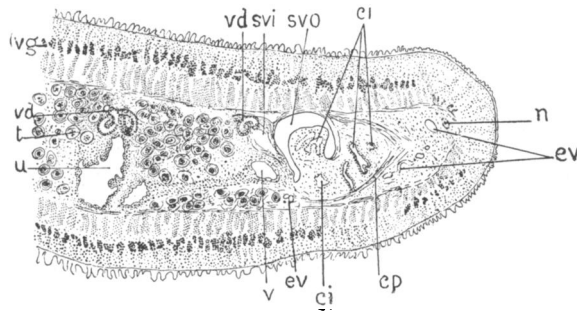


Fig. A.—Transverse section of young proglottis showing cirrus pouch, seminal vesicles, vagina, uterus, etc.; dorso-ventral diameter 1.26 mm.

However, there are some variations from the ordinary arrangement. In the series from which Text fig. A was made, transverse sections of a young proglottis, the largest excretory vessel is dorsal and passes to the dorsal side of the cirrus pouch, dividing into two or more branches in passing, the branches uniting after passing the cirrus pouch. There were three or more small vessels which were ventral. In a transverse series of an adult proglottis only the larger vessel was clearly indicated. It passed without dividing on the dorsal side of the cirrus pouch. In a few sections a smaller vessel was seen lying very close to the larger vessel on its dorsal side. In a series of sagittal sections of immature proglottides the larger vessel is distinctly ventral, and the smaller, dorsal.

In a series of adult proglottides the larger vessel is not distinctly either dorsal or ventral. It passes on the dorsal side of the cirrus pouch. The smaller vessel is dorsal.

Strobila.—The general aspect of the strobile suggests that of the Bothriocephalidæ, the proglottides being indistinctly indicated, even

those which are fully mature and have the uterus filled with eggs and occupying the greater part of the interior of the proglottis. The habit is rather thickish thruout. In preserved specimens the margins, in the median region especially, are finely wrinkled, but the middle of the flat faces of the strobile, dorsal and ventral, is for the most part smooth, with a tendency to develop longitudinal wrinkles in the anterior regions (Fig. 15).

In a specimen 680 mm. in length, the diameter just back of the contractile bulbs, at the beginning of the strobile proper, is 2.25 mm. From this point the strobile increases gradually and rather uniformly in width for some 300 mm., when the greatest width, 8 mm., is attained. From that point to the posterior end the breadth remains about the same; a few of the posterior segments which are filled with eggs, are thicker and not quite so broad. The posterior segment is 7 mm. long and 7 mm. broad, and nearly 3 mm. thick. The first segments with ova, so far as their presence could be made out, were 380 mm. from the anterior end. Here they could be seen as a dark central mass thru the thick, but partly translucent, wall. The proglottides are but faintly outlined at best, but by careful study with the aid of the hand lens they could be made out. The first recognized were 100 mm. from the anterior end, and were 3 mm. broad and 0.75 mm. in length.

The genital openings are asymmetrically marginal and irregularly alternate. They are rather difficult to make out since, unless the cirrus is everted, each is at the bottom of a deep notch which is often by contraction of the proglottis reduced to a thin line indistinguishable from the other marginal wrinkles of the proglottis. In young and maturing proglottides the genital aperture is situated a little behind the middle of the length; in older segments it is about, or a little in front of, the posterior third of the length. The lateral margins of the posterior proglottides are nearly entire. Toward the posterior end the posterior margins of the proglottides can be seen to possess a free but very narrow border. The ventral uterine openings, which were demonstrated in sections to lie near the middle of the anterior border of the proglottis, were not seen in any case in the macroscopic study of the strobile (Figs. 13, 12).

When the strobile is allowed to become slightly dry it shows under the hand lens the surface covered with what appear like minute scales. In sections these are seen to be cuticular papillae, which are spine-like and point posteriad; they evidently function to help hold the strobile in place and hence tend to relieve the drag on the proboscides when they are acting as an anchorage. This structure is in harmony with the long and heavy strobile which follows the thick walled structure, and the tendency of the ripe proglottides to remain attached. No free proglottides were found, and the ripe proglottides showed no tendency to separate from the strobiles.

The cirrus was everted in but few of the proglottides. It is smooth, tapering, and rises from the larger end of a funnel-shaped base. The shape of this basal portion suggests that it may function as an adhesive sucker-like organ in copulation. In a segment measuring about 5 mm. in breadth, and 3.75 mm. in length, the middle of the base of the cirrus was 1.3 mm. from the posterior end; the length of cirrus, including basal portion 2.32 mm., the length of basal funnel 0.45 mm., the diameter of funnel at base 0.21 mm., at the outer extremity, which forms a collar from which the cirrus proper rises, 0.60 mm., the diameter of the cirrus proper at base 0.30 mm., at tip 0.16 mm. (Fig. 14).

The cuticular papillary spines, as shown in a mounted specimen under moderate magnification, are short, conical, bluntly pointed, translucent, horn-like in structure, and strongly deflected posteriorly. They are somewhat variable, but the better developed ones measure 0.07 to 0.09 mm. in length, and 0.03 mm. in diameter at base, tapering to 0.015 mm. at tip.

Anatomy of Proglottis.—The wall of a mature proglottis is relatively thick. In a section measuring 1.15 mm. in the shorter diameter, it was 0.3 mm. thick exclusive of the cuticular papillæ, which were rubbed off from portions of the section. They would add about 0.07 mm.; that is, 60% of the thickness of the segment is represented by the walls. The thickness of the layers is slightly variable. The lobes of the vitellaria, for example, present an irregular outline, especially where they join the sub-cuticular layer, into which they penetrate to greater or less degree. Measurements made in a transverse section of a segment with eggs gave the following result: Thickness of cuticular layer, exclusive of papillæ, 0.006 mm., of sub-cuticular layer 0.054 mm., of vitelline layer 0.090 mm., of longitudinal muscle layer 0.108 mm., of circular muscle layer 0.012 mm.

The wall is relatively thicker in immature than it is in mature proglottides; in a proglottis 1.12 mm. thick without vitellaria but with testes and rudiments of other genitalia the wall was 0.42 mm. thick, distributed as follows: cuticula, exclusive of papillæ, 0.006, subcuticula 0.13, longitudinal layer 0.27, circular layer 0.014 mm.

The general anatomy of the reproductive organs is shown in sketches of sections and in diagrammatic restorations.

The cirrus has already been described. When retracted it is seen to enter the common duct from the anterior side. The cirrus-pouch is large and in the retracted state of the cirrus extends rather more than half way from the lateral margin to the median line of the proglottis. The vas deferens is a much convoluted tube between the cirrus-pouch and the middle of the segment. It passes to the dorsal side and lies in convoluted folds on the dorsal side of the uterus along the median axis from a point a little back of the middle of the length of a mature

proglottis to the ovary. The testes are very numerous and fill all the space bounded by the circular muscle layer not occupied by the other genitalia. They are not completely interrupted at the junction of proglottides with each other. This is best seen in sagittal sections. The testes are the first of the reproductive organs to appear and in the younger segments fill practically all the space in transverse sections inside the muscular walls. The male reproductive organs mature before the female. In mature segments the testes are conspicuous organs, appearing as globular cell masses, deeply staining in carmine, and surrounded by spermatozoa, which present the appearance of concentric layers of fine fibers.

The vagina opens on the margin of the proglottis at the common genital pore, which, when the cirrus is retracted, is at the bottom of a deep notch. It lies along the posterior border of the cirrus pouch, and is a relatively large tube. In a sagittal section made at the level of the base of the cirrus bulb the section of the vagina occupied one-fifth of the thickness of the segment, and was filled with spermatozoa. The vagina follows a course nearly at right angles to the lateral margin as far as the middle line where, as the relatively large seminal receptacle, it lies on the ventral side of the segment on the median line as far back as the anterior border of the ovary. A slender tube, the sperm duct, with rather thick walls extends from the base of the spacious seminal receptacle to the germ duct. It rises from an inwardly projecting papilla on the wall of the receptacle. After making a sharp turn, which forms nearly one coil of a spiral, it proceeds back in a curved course to the germ duct which it joins at the posterior end of an enlarged portion of the duct near the ovary. A very short distance back of the point where the germ duct is joined by the sperm duct a vitelline duct enters. The vitelline ducts from the two sides appear to join in a common duct shortly before entering the oviduct. The germ duct for a short distance back of the point where it leaves the ovary (germarium), which is on the ventral side, is enlarged, with thick walls surrounded by conspicuous gland cells. It is thick-walled until a short distance back of the point where it is joined by the vitelline duct. It then passes to the dorsal side where it is disposed in several coils. Here its walls are thin. These coils of the oviduct lie in a space which is filled with parenchyma characterized by very few small cells in a mesh of exceedingly fine fibers. This space is surrounded by the cells of the shell gland, which are large, oval, or fusiform with conspicuous nuclei. The diameter of the germ cells is 6μ , while the cells of the shell gland are 18μ long. The earlier coils of the thin-walled portion of the oviduct contained only scattered yolk cells. The duct became more and more crowded with yolk cells, and considerably enlarged, ova and masses of yolk cells lying together in its lumen. The anterior coils contained only ova and merged into the uterus proper.

The uterus in immature proglottides is represented by a slender tube which lies on the ventral side along the median line. It communicates with the exterior by a ventral pore near the anterior end of the proglottis. In young adult proglottides in which ova have made their appearance the uterus is more or less spacious, with a tendency to become sacculated. As the proglottides mature these sacculations extend laterad until, in the posterior segments, all the interior space within the muscular layers is occupied by the uterus crowded with eggs. The eggs are elliptical-ovate, and thin shelled with little or no variation in the size, measuring 60μ by 30μ .

The conspicuous vitelline glands lie between the layer of longitudinal muscles and the subcuticula. They form a relatively thick layer which is interrupted only over a small area dorsal and ventral to the shell gland and ovary in mature joints. The vitellaria are practically continuous at the margins, and at the anterior and posterior ends of the joints, where sagittal sections show at some places the vitelline glands of adjacent joints merging imperceptibly into each other, at others separated by very thin septa. The ovary has two lobes united at the median line. The whole organ occupies approximately one-fifth of the length and a little more than half the breadth of a mature proglottis, and lies at the extreme posterior end.

THE CLASSIFICATION OF THE TETRARHYNCHIDAE

The classification of those cestodes which are characterized by the presence of four eversible proboscides armed with hooks is still in a somewhat unsettled condition.

The genera which I have recognized in previous papers are: *Rhynchobothrium* de Blav., *Otobothrium* Lt., *Tetrarhynchus* Rud., and *Synbothrium* Dies.

These genera may be recognized from the scoleces alone by the following characters:

Bothria 2	
Bothria plain.....	<i>Rhynchobothrium</i>
Bothria with two eversible pit-like organs at posterior border..	<i>Octobothrium</i>
Bothria 4	
Bothria lateral (dorso-ventral).....	<i>Tetrarhynchus</i>
Bothria terminal.....	<i>Synbothrium</i>

The generic name *Rhynchobothrium* is not used by some recent writers.

Following is the classification of the Tetrarhynchidæ proposed by Pintner (1913):

1. *Eutetrarhynchus* Pint. 1913
 - Type: *Eutetrarhynchus ruficollis* (Eysenh.)
 - Spiral valve of *Mustelus laevis*

2. *Stenobothrium* (Diesing 1863)
Type: *Stenobothrium linguale* (Cuv.)
Stomach of *Mustelus*
Tetrarhynchus tenue, *T. robustus*, and *T. bisulcatum* of my papers fall in this group
3. *Lakistorhynchus* Pint. 1913
Type: *Lakistorhynchus benedeni* (Créty)
(= *tenuis* Ben. = *gracilis* Dies.)
Spiral valve of *Mustelus*
4. *Halysiorhynchus* Pint. 1913
Type: *Tetrarhynchus shipleyanus* Pint. 1913
(New name for *T. ruficollis* Sh. and Horn. 1906)
From *Trygon walga*
5. *Sphyricephalus* Pint. 1913
Type: *Sphyricephalus viridis* (Gu. R. Wagner)
Stomach of *Centrophorus granulosus* and *Scymnorphynus lichia*
6. This generic group is not given a name by Pintner, who simply designates it as the "*Attenuatus*" Group, to which belong: *Tetrarhynchus attenuatus*, *grossus*, *megacephalus*, *Coenomorphus*, and other forms.
7. This group, also without a formal generic title, is made to accommodate *Otobothrium* Lt.

While recognizing the need of a revision of my contributions to the literature of this group, I do not propose to venture upon the task at present. On account of the wide distribution of these cestodes in the encysted stage, where scoleces may be found fully developed, but with no proglottides, it is highly desirable that whatever classification is devised, it should be usable with the encysted stages for the larger groups, preferably genera. It is true that there is great diversity of form and habit in the strobiles, but it is not likely that scoleces which agree in details of structure, including the armature of the proboscides, will be found to differ generically in their strobiles. It is of great importance that descriptions of scoleces should, as far as the material will enable it to be done, include detailed accounts and figures of the hooks, with measurements, also measurements of the different parts of the scolex.

The species under consideration possesses some characters which suggest a form which I have recorded, from scoleces obtained from cysts, as *R. speciosum*. Upon comparing the scolex of this species with scoleces of *R. speciosum*, however, it is seen that we are dealing with a different species. On the other hand a comparison with unidentified species of the genus *Rhynchobothrium* it was noted that a scolex obtained from a cyst in *Mola mola* (Linton 1901) agrees very closely with this species. Unfortunately I am unable to find the specimen in my collection upon which the brief description was based and from which the figures were made. There is a second longitudinal row of slender hooks placed by twos in tandem, represented in the figures

which I do not find in my study of the hooks of the specimens described in this paper. It should be added that this second row of hooks placed by twos is characteristic of *R. speciosum*.

The proboscides of *R. speciosum* are longer and more slender than the proboscides of *R. ingens*. Thus the proboscis of *R. ingens* was estimated to be 2.8 mm. in length, and at one point measured 0.2 mm. in diameter, including hooks. The proboscis of a scolex from a cyst found in *Alutera schoepfi*, which agrees with *R. speciosum*, measures about 2 mm. in length and 0.1 mm. in diameter, including hooks. The length of the proboscis in scoleces identified as *R. speciosum* has been estimated in some cases to be as much as 4 mm. The length of the longest hooks in *R. ingens* is about 75 μ , of *R. speciosum*, about 50 μ .

Rhynchobothrium ingens sp. nov.

Bothria two, neck of scolex elongate, subcylindrical, merging into strobile without collar (acraspedote, Pintner); characters of genus.

Bothria broader than long, emarginate on posterior border, flaring in marginal view. Proboscides rather long, armed with hooks of considerable variety of shape, arranged in about 13 longitudinal rows, of which 5 are of stout, recurved hooks placed near together, 5 of longer, straight hooks slightly curved at the extremity, also placed near together, one row of small, slender-pointed curved hooks adjacent to the group of stout, recurved hooks, one of very variable short hooks with broad bases, adjacent to the group of long straight hooks; between the two latter rows is a row of small slender-pointed hooks placed by twos in tandem. This description for the hooks near the base of the proboscis. Contractile bulbs slender slightly arcuate.

Strobile long and thick, 700 mm. or more in length, and 7 mm. or more in breadth; proglottides rather indistinct except toward the posterior end; reproductive apertures irregularly alternate, behind middle of length of proglottis: cirrus smooth, with a funnel-shape collar at base. Vagina posterior to cirrus. Uterus with a minute opening to the exterior situated ventrally near the anterior end of the proglottis on the median line. Ripe proglottides not separating easily, if at all, from the strobila. Cuticula of strobila raised into minute papillary spines.

<i>bl</i> contractile bulbs.	<i>prs</i> proboscis sheath.
<i>cb</i> calcareous body.	<i>sd</i> sperm duct.
<i>ci</i> cirrus.	<i>sg</i> shell gland
<i>cp</i> cirrus pouch.	<i>sr</i> seminal receptacle.
<i>ev</i> excretory vessel.	<i>svi</i> inner seminal vesicle.
<i>evd</i> dorsal excretory vessel.	<i>svo</i> outer seminal vesicle.
<i>evv</i> ventral excretory vessel.	<i>t</i> testis.
<i>ga</i> genital aperture.	<i>u</i> uterus.
<i>gc</i> ganglion cell.	<i>ua</i> uterine aperture.
<i>gd</i> germ duct.	<i>v</i> vagina.
<i>n</i> nerve.	<i>vd</i> vas deferens.
<i>o</i> ovary (germarium).	<i>vg</i> vitellaria
<i>ov</i> oviduct.	<i>vd</i> vitelline duct
<i>pr</i> proboscis.	

I am indebted to Mr. George T. Kline, Biological Artist of the University of Missouri, for the greater part of the work involved in the preparation of illustrations for this paper.

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- Pintner, Th. 1913.—Vorarbeiten zu einer Monographie der Tetrarhynchoideen, Sitzunb. d. K. Ak. d. Wiss., 122:171-253.

EXPLANATION OF PLATE IV

Plate IV.—Fig. 1.—Scolex of *Rhynchobothrium ingens*. Diagrammatic sketch of scolex, marginal view, showing distribution of ganglion cells; length of scolex 9.5 mm.

Fig. 2.—Transverse section of bothria, showing anastomosing excretory vessels, retracted proboscides, etc. Dorso-ventral diameter 1.16 mm.

Fig. 3.—Enlarged view of section of border of Bothrium.

Fig. 4.—Transverse section of neck of scolex showing ganglion cells, excretory vessels, etc. Shorter diameter of section 1 mm.

Fig. 5.—Diagram of proboscis, split longitudinally and partly flattened; for significance of letters a-e, see text.

Fig. 6.—Bothrium, front view; breadth 2 mm.

Fig. 7.—Two of larger hooks of series b, Fig. 5, seen in side view, optical section.

Fig. 8.—Hook from series e, Figure 5.

Fig. 9.—Hooks from series b, Figure 5.

Fig. 10.—Hook from series d, Figure 5.

Fig. 11.—Median region of transverse section made near the posterior end of a mature proglottis, dorso-ventral diameter 1 mm.

LINTON—RHYNCHOBOTHRIUM INGENS SPEC. NOV.

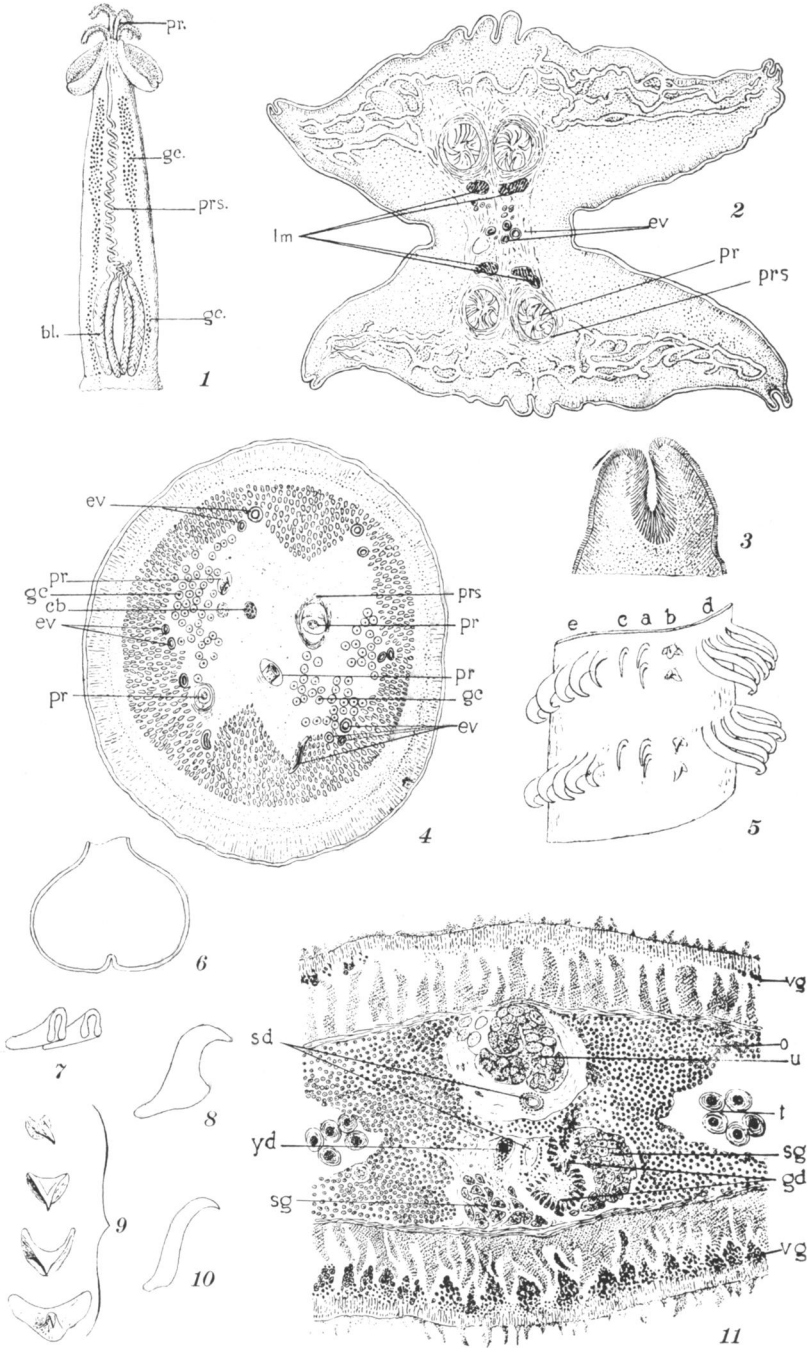


PLATE IV

THE JOURNAL OF PARASITOLOGY

EXPLANATION OF PLATE V

Plate V.—Fig. 12.—Stereogram of mature proglottis, ventral view.

Fig. 13.—Median sagittal section at junction of two mature proglottides; dorso-ventral diameter 1 mm. Three adjacent sections were used in order to show the sperm duct and vitelline duct joining the germ duct.

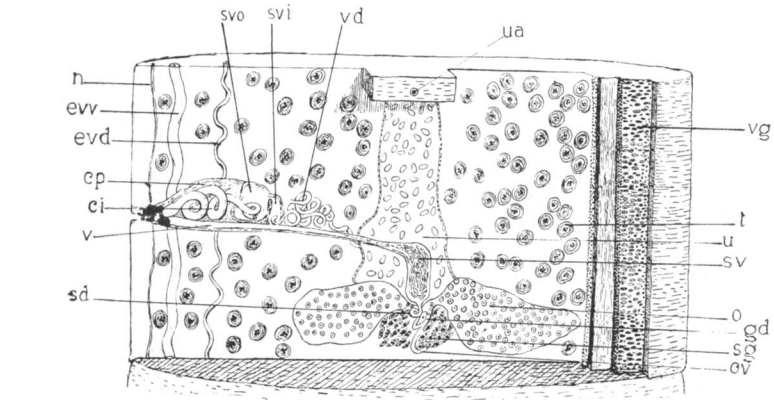
Fig. 14.—Enlarged view of everted cirrus, length 2.3 m.m.

Fig. 15.—Portion of strobile representing four proglottides. Note that the genital aperture is visible in the lower, while it is not visible in the upper proglottis. This is because the apertures are not quite symmetrically placed on the margins of the proglottides; breadth 5.5 mm.

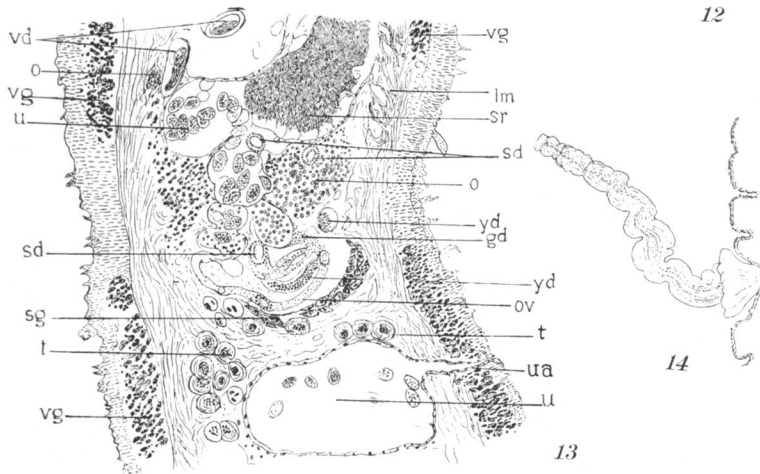
Fig. 16.—Schematic sagittal view of reproductive organs of adult proglottis in median region of proglottis.

For explanation of lettering on all figures see p. 31.

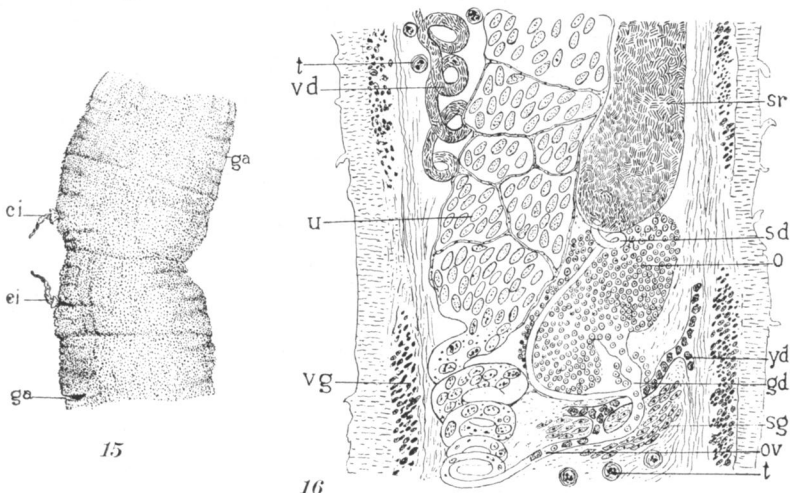
LINTON—RHYNCHOBOTHRIUM INGENS SPEC. NOV.



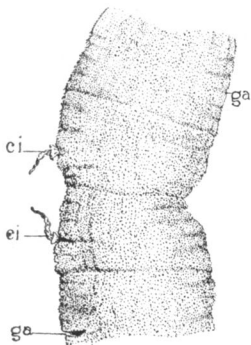
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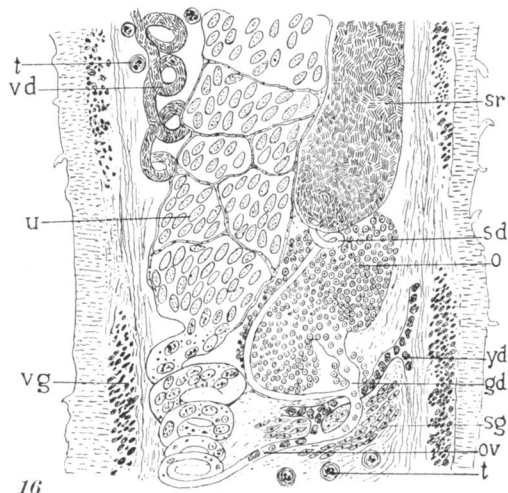
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14



15



16

PLATE V